EUROGEO WORKSHOP 2022

An Early Warning Tool to the epidemics arsenal.

Bridging the gap between the VBD challenge & the solution

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On behalf of EYWA team

Winner of the first "EIC Horizon Prize on Early Warning for Epidemics"

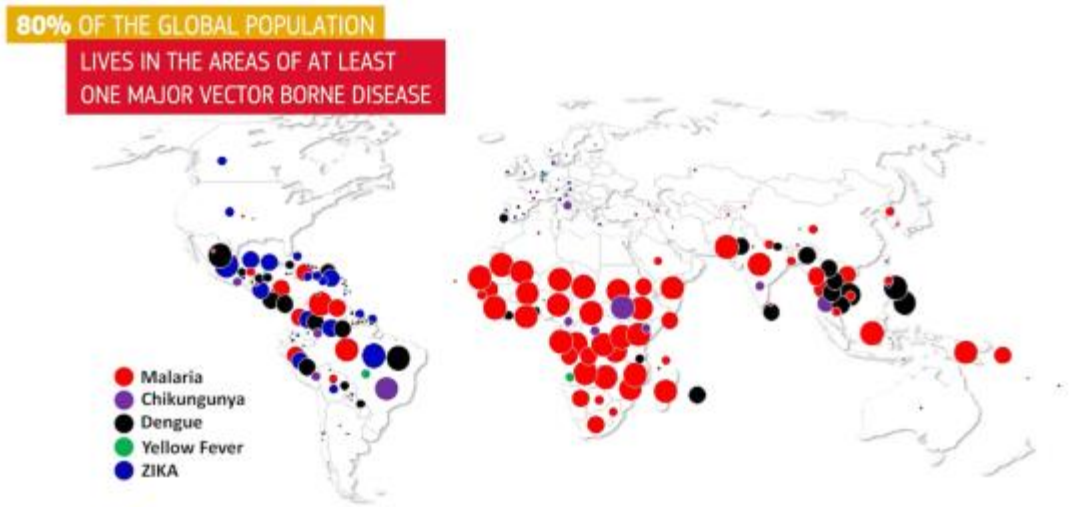
Learn more here:

e-shape

The e-shape project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 820852

ATHENS 7-9 DECEMBER 2022

Introduction | MBDs: A global problem to be addressed



Re-emergence of significant mosquito born disease, including outbreaks, reported native and imported cases (2017-2019)

- **Climate Change**, **globalisation** and other drivers are altering ecological conditions for **mosquitoes**.
- Mosquito-Borne Diseases (MBDs) are present in **over 100 countries**.
- 700,000 deaths per year.
- **Malaria**, most lethal for kids aged under five in the sub-Saharan regions.
- **Europe** a "hot spot" of **West Nile Virus**.
- **Chikungunya** and **dengue fever** increased 40% over 1950[1].

1. https://www.thelancet.com/action/showPdf?pii=S0140-6736(20)32290-X

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EYWA & West Nile Virus in Europe

Greece

- **1702 cases and 227 deaths** in the past 12 years.
- **EYWA** supports **4 regions** with a total of **2500 settlements** and **3.8M people**.
- Entomological risk predictions powered by the **BAd (Ecodev)** and **MAMOTH (BEYOND/NOA)** models.
- Epidemiological risk predictions powered by the **BAr (Ecodev)** and **MIMESIS (Uni of Patras)** models.

Italy

- **EYWA** supports **2 regions** with a total of **757 municipalities** and **540K people**.
- Entomological risk predictions powered by the **MAMOTH (BEYOND/NOA)** model.
- Epidemiological risk predictions powered by the **BAr (Ecodev)** and **MIMESIS (Uni of Patras)** models.

Serbia

- **Vojvodina region 37 municipalities** and **1.9M people**.
- Entomological risk predictions powered by the **MAMOTH (BEYOND/NOA)** model.

- **West Nile Virus** outbreaks have been registered in all of **southern Europe**.
- Starting to register cases in 2010, the disease had extreme outbreaks in multiple countries in **2018** with **1549** cases and **166** deaths in a year.
- In 2022 there is another outbreak ongoing in cases with **939** cases and **68** deaths so far.
- Overall **4989 cases and 437 deaths** in the past **12 years**.
- EYWA supports 11 regions in Europe for a total of **10.909 municipalities** and more than **34M people** living in them.

Germany

- **Baden-Württemberg region 74 municipalities** and **11.1M people**.
- Entomological risk predictions powered by the **MAMOTH (BEYOND/NOA)** model.

France

- **3 regions / 9935 municipalities** and **~12 M people**.
- Entomological risk predictions powered by the **MAMOTH (BEYOND/NOA)** model.

EYWA supported European regions

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EYWA & MBDs in Ivory Coast

Mosquito Threats in Ivory Coast:

- ❑ Aedes Aegypti spread Dengue Fever, Chikungunya, Yellow fever, Zika fever and more disease agents
- ❑ Anopheles spread Malaria

Malaria in 2020:

- ❑ 26.378.275 **population at risk**, 7.434.595 **suspected** cases, 4.587.859 **confirmed** cases, 2.252.312 in **children under 5**, 103.947 **severe** cases, 1.315 **deaths**.

Dengue fever outbreaks:

- ❑ 2017[3]: 623 **suspected** cases, 2
- ❑ Outbreaks in **Abidjan**
  6.321.017.

MAMOTH EYWA model already established operationally.

1. https://www.cdc.gov/globalhealth/countrie
2. https://www.sciencedirect.com/science/art
3. https://www.who.int/emergencies/disease-o
   2017-dengue-cote-d-ivoire-en
4. https://www.africanews.com/2022/05/04/dengu
   11-cases-recorded-in-ivory-coast//

EYWA & MBDs in Thailand

Dengue fever:

- ❑ Dengue is hyper-endemic and all 4 serotypes are in active circulation in Thailand (home to around **69 million individuals**).
- ❑ Two dominant dengue mosquito vectors, **Aedes aegypti** and **Aedes albopictus**
- ❑ Each of the 77 provinces in Thailand have on average, non-zero reported dengue case counts over the past 10 years[1].
- ❑ Large outbreaks in 2013, 2015 and 2019 with 153.765, 141.375 and 128,964 respectively[2].

Chikungunya:

- ❑ Thailand experienced outbrea
  2009 (49.069 cases[3]), and
  (approximately 15.000 cases[4]).

Transferable MAMOTH EYWA model enabled cooperation with Thailand and Ghana stakeholders

1. https://bmcinfectdis.biomedcentral.com/articles/10
   05666-4
2. http://outbreaknewstoday.com/thailand-infectious-di
   measles-dengue-and-melioidosis-30041/
3. https://www.ajtmh.org/view/journals/tpmd/90/3/article-
4. https://pubmed.ncbi.nlm.nih.gov/33690657/

MBDs in Ghana

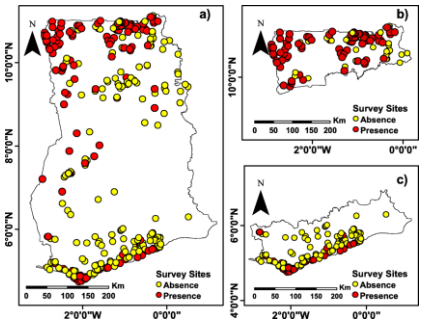
Malaria (2020 data):

- ❑ 31.072.945 **population at risk**, 5.879.506 **suspected & confirmed** cases, 12.084 **estimated deaths**.

Lymphatic Filariasis (2017 data):

- ❑ A cumulative total of over 74M people were treated, giving an estimate of large number of people affected.
- ❑ 22 districts defined as "hotspots" (even after mass drug administration programs) with virus prevalence above the recommended 1% level.
- ❑ Vector control has been shown to greatly impact the transmission of LF[1,2] , with vector control strategies.
- ❑ EYWA can make an impact by guiding these strategies.

1.https://www.annualreviews.org/doi/10.1146/annurev.ento.54.110807.090626
2.https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0005280#



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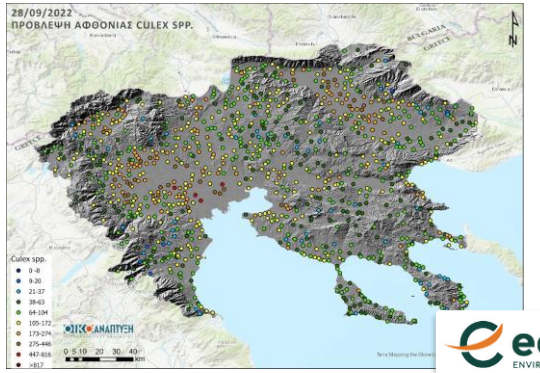
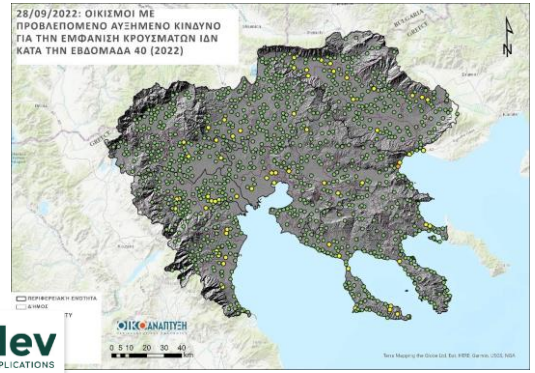
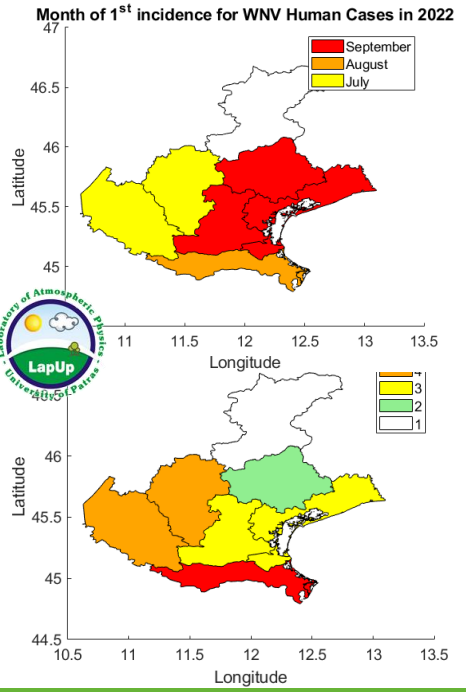
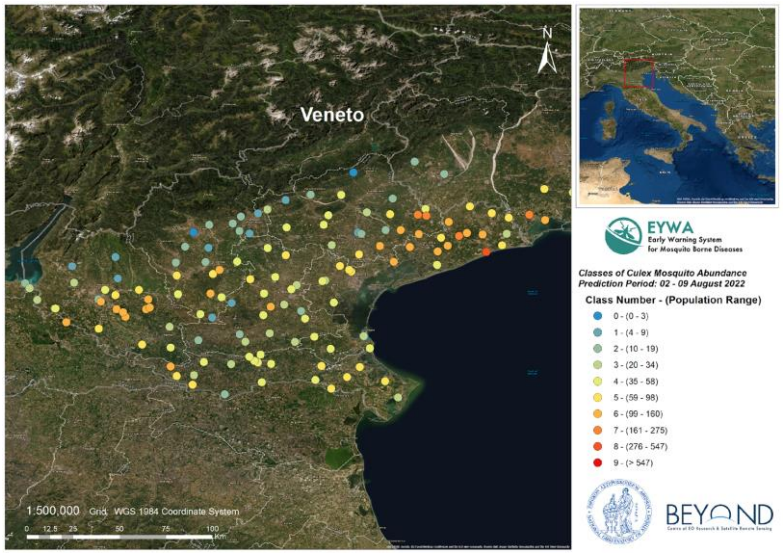
Working towards a solution

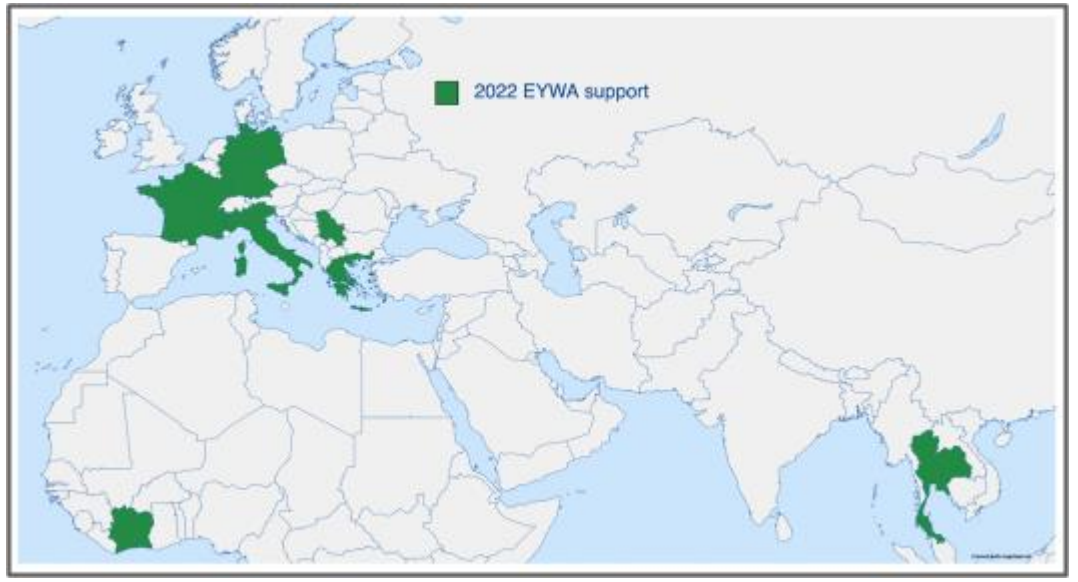




ecodev
ENVIROMENTAL APPLICATIONS







What does EYWA offer?

A couple of weeks/one month earlier it informs on mosquito abundance and pathogen transmission and suggests preventive and awareness door-to-door actions in the villages at risk

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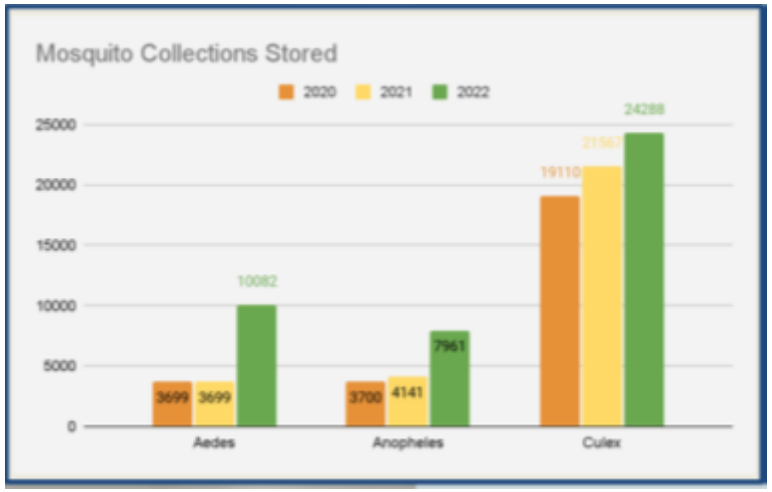
A fragmented landscape

Before EYWA:

- Siloed collections Entomological & epidemiological records
- Lack of data providing dynamics:
  - Environment, weather, landscapes hosting areas mosquitoes
- No Standardization in feature engineering to feed AI/Dynamic forecasting models
- No robust/transferable solutions



What is new in the concept of EYWA ?

After EYWA

EYWA set the stage for:

- Data centralization in a common database
- Big features spaces of environment al, entomological, health, socio-economic, climatic data
- Validated Transfer Learning models

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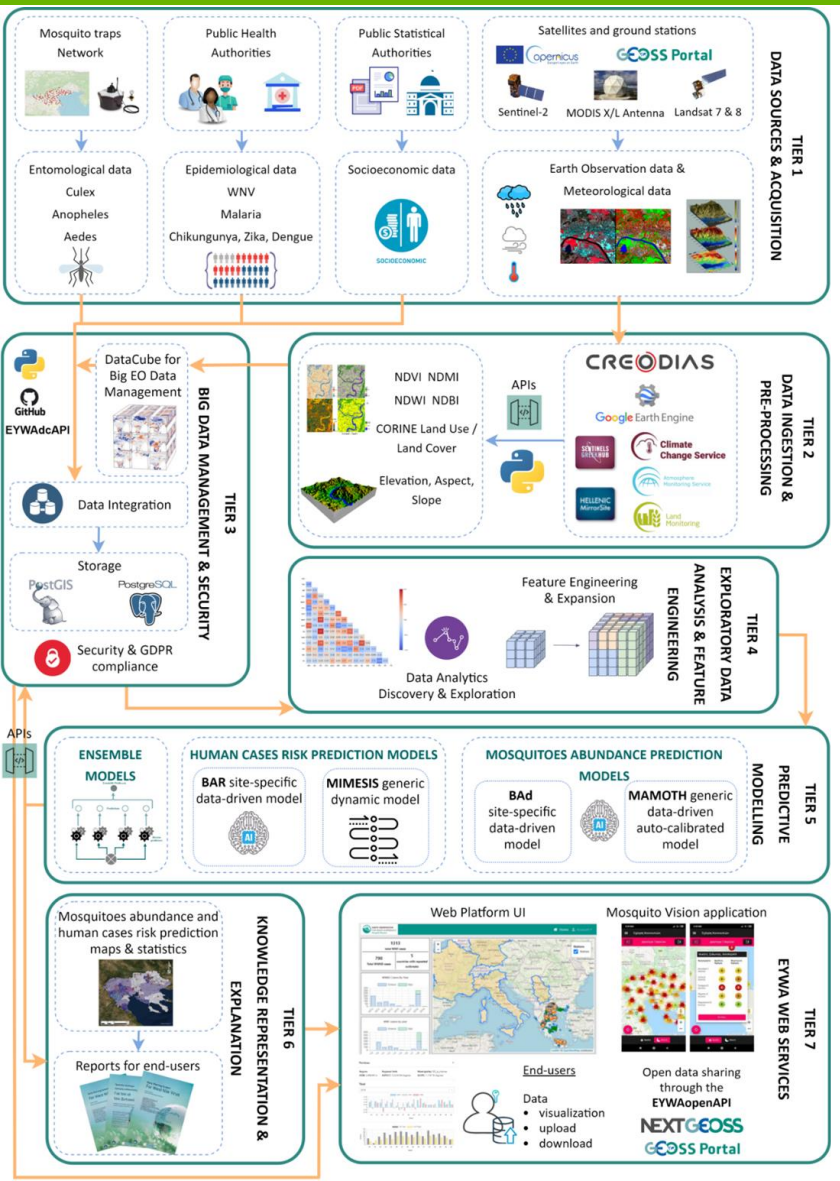

What/Where does EYWA provide as models for Early Warning?

WNV risk

- ❑ **MIMESIS (Univ. of Patras)**
  - **Municipality** level.
  - **Monthly** predictions.
  - Predicted probability/number of WNV cases & expected first week of registered case.
- ❑ **BAr (ECODEV)**
  - **Settlement** level
  - **Weekly** predictions
  - Predicted **probability WNV case**.

Mosquito Abundance

- ❑ **BAd (ECODEV) abundance** model
  - **Settlement** level
  - **Weekly** predictions
- ❑ **MAMOTH (NOA)**
  - **Point/Trap** level.
  - **Aggregate** predictions for any **larger** area
  - **Biweekly/Monthly** predictions.

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In a nutshell

- **EYWA** is an established **impactful** & **transferable** Early Warning System.
- The system is **expanding** each year **to new regions** dealing with different climatic & socioeconomic conditions.
- The **sustainability** issue per use case is carefully examined and justified only if Institutional users are actively involved as co-designers
- Models are adapted in providing **early warning** and guiding **targeted** larviciding and **door to door** awareness based on **user feedback** at the end of each mosquito season
- The identification of **means/channels/networks** to disseminate the EYWA products are first ranked priorities
- Established and **standard collection and access** to EO and in-situ entomological and health records are key aspects that EYWA highlights and prioritize to involved authorities
- Highlights the power of **EO** in supporting **Communities** and **Health Systems** around the world and as an Action Group seeks for synergies with on-going projects and initiatives (e.g. EO4Health).

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Thank you!

Earth Observation for Epidemics
of Vector-borne Diseases /
EuroGEO Action Group

EuroGEO

Contact us
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18 Partners | 7 Countries

Greece

National Observatory of Athens (NOA) – BEYOND Centre of EO Research & Satellite Remote Sensing

Ecodevelopment S.A

University of Patras – Physics Department - Laboratory of Atmospheric Physics (LapUP)

Dimitrios Vallianatos (IDCOM)

Aristotle University of Thessaloniki

University of Thessaly, Medical School. Laboratory of Hygiene and Epidemiology

Italy

Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe)

Edmund Mach Foundation

University of Trento

Serbia

University of "Novi Sad", Faculty of Agriculture, Laboratory for Medical and Veterinary Entomology

Scientific Veterinary Institute "Novi Sad"

University of Novi Sad, Faculty of Medicine

Germany

German Mosquito Control Association (KABS)

Bernhard Nocht Institute for Tropical Medicine

France

EID Méditerranée

European Commission

Joint Research Center

Ivory Coast

Centre Suisse de Recherches Scientifiques en Côte d'ivoire

Thailand

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